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Technology Transition Brief

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TARDEC – VEA / CBM

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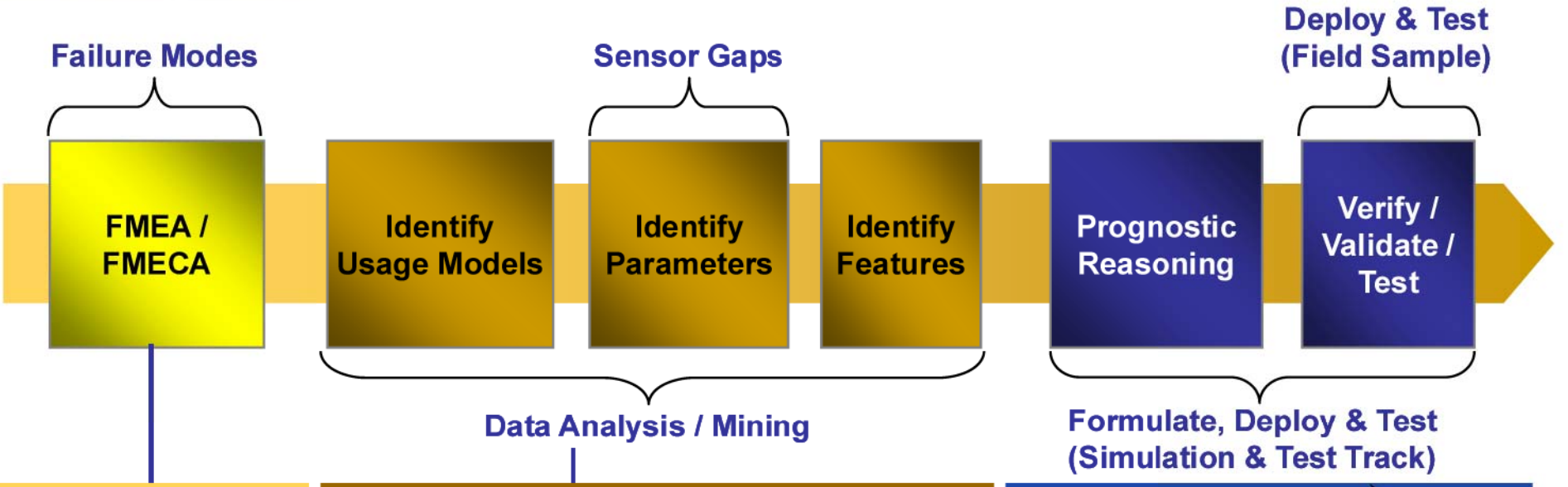
Prognostics & Diagnostics Value Chain



Component Targets :
- Powertrain
- Track
- Batteries

FMEAs Developed:
- Abrams transmission
- Bradley transmission

Data Modeling :
- Identify data elements
- MIMOSA DW Prototype

Analysis :
- Identify correlations in sensor and logistics data sets

Analytical Tools :
- Pugh Analysis (tool capabilities)
- Tool Evaluations using AMSAA SDC Data Sets (LMTV,HEMTT, M915/916)

Prognostics & Diagnostics :
- Fault isolate to component
- Predict impending failures

Actionable Information

Decision Support :
- Derive actionable information from data sets
- Trigger supply/maintenance processes

TACOM ILSC, RDECOM (TARDEC/AMSAA/ARL), LOGSA, and LCMC PMs

Turning raw sensor data and logistic data into actionable information…

Advanced Diagnostics for Diesel Engines

Diesel Engine Characterization

Schedule & Cost

Milestones	FY08 2-4Q	FY09 1-2Q	FY09 3-4Q	FY10 1Q
Analysis of AMSAA SDC Data				
Engine Baseline Characterization				
Algorithm Development				
Seeded Fault Testing				
Algorithm Val/Ver				
TOTAL $ 1,190K				

Purpose:

This effort will focus on the Diesel Engine used by the LMTV and Stryker and involves:

- Development of health assessment models and algorithms for ground vehicle diesel engines through seeded fault and durability analysis at the component level
- Identification of sensor strategies that could be implemented in a ground vehicle application to allow for accurate diagnosis of impending faults

Products:

- Algorithm approach through sensor and data analysis
- Self-learning Neural Network approach to Condition Based Maintenance that can be expanded to other engines, sub-systems and vehicles
- Library of model signatures based on seeded fault testing

Payoffs:

- Provide critical insight into sensors required for diagnosis of diesel engine health and prediction of Remaining Useful Life (RUL)
- Demonstrate how CAN data and neural software can be used to create virtual sensors that can be used for health monitoring
- Demonstrate fault prediction by inducing failures into engine on TARDEC's dynamometer test cell
- Provide Government owned knowledge that can be applied across a variety of vehicle platforms

Transmission Health Assessment

Schedule & Cost

Milestones	FY10 1Q	FY10 2Q	FY10 3Q	FY10 4Q
FMEA and Failure Mode Selection				
Component Testing & Data Analysis				
Model & Algorithm Development				
Vehicle Testing & Algorithm Refinement				6
TOTAL $ 500K FY10 Funding Plan				

Purpose:

This internal TARDEC effort will focus on the Bradley, commercial bus and future truck transmissions and involves:

- Development of health assessment models and algorithms for ground vehicle transmissions through seeded fault and durability analysis at the component level
- Identification of sensor strategies that could be implemented in a ground vehicle application to allow for accurate diagnosis of impending faults
- Evaluation of the potential Return on Investment (ROI) for implementing this technology in a vehicle
- Collaboration with AMSAA to evaluate the developed algorithms in a vehicle environment

Products:

- Prognostic and Diagnostic algorithms for selected failure modes
- Sensor strategy for vehicle implementation
- CBA / ROI Analysis

Payoffs:

- Provide critical insight into sensors required for diagnosis of transmission health and prediction of Remaining Useful Life (RUL)
- Allow for replacement of the transmission component prior to a failure that could potentially damage batteries or dead-line a vehicle
- Provide Government owned knowledge that can be applied across a variety of vehicle platforms

Alternator Health Assessment

Purpose:

This internal TARDEC effort involves:

- Development of health assessment models and algorithms for ground vehicle alternators through seeded fault and durability analysis at the component level
- Identification of sensor strategies that could be implemented in a ground vehicle application to allow for accurate diagnosis of impending faults
- Evaluation of the potential Return on Investment (ROI) for implementing this technology in a vehicle
- Collaboration with AMSAA to evaluate the developed algorithms in a vehicle environment

Products:

- Prognostic and Diagnostic algorithms for selected failure modes
- Sensor strategy for vehicle implementation
- CBA / ROI Analysis

Payoffs:

- Provide critical insight into sensors required for diagnosis of alternator health and prediction of Remaining Useful Life (RUL)
- Allow for replacement of the alternator component prior to a failure that could potentially damage batteries or dead-line a vehicle
- Provide Government owned knowledge that can be applied across a variety of vehicle platforms

Schedule & Cost

Milestones	FY09 4Q	FY10 1-2Q	FY10 3-4Q	FY11 1-2Q
FMEA and Failure Mode Selection				
Component Testing & Data Analysis				
Model & Algorithm Development				
Vehicle Testing & Algorithm Refinement				6
TOTAL $ 200K FY09 – FY10 Funding Plan				

Battery Aging Study

Li-ion

PbA

Purpose:

Development of cumulative aging models for both current fleet and hybrid batteries through durability testing under military duty cycles. These will allow for the prognosis of battery aging, and an accurate prediction of the Remaining Useful Life (RUL) of batteries. Identification of sensor strategies that could be implemented in a ground vehicle application. Development of on-board diagnostic tests to determine the instantaneous battery health.

Products:

- Aging models for both Li-ion and PbA batteries based on military duty cycles.
- State of Charge (SoC) and State of health (SoH) algorithms for batteries based on the developed models.

Payoffs:

- Provide calendar or mileage based (RUL) estimation for batteries based on military specific duty cycles.
- Leverages experience in battery aging processes developed through work with industry.
- Leverages NAC Investment

Schedule & Cost

Milestones	FY08 4Q	FY09 1-2Q	FY09 3-4Q	FY10 1-3Q
Define Relevant Duty Cycles				
Battery Aging Cycle Test				
Model Development				
Algorithm Development				6
TOTAL $ 400K				

Tactical Wheeled Vehicle CBM SIL

Purpose:

To develop a Tactical Wheeled Vehicle System Integration Lab (SIL) that will be utilized to asses, test, and evaluate various COTS/GOTS software & hardware and vehicle electrical data buses. The SIL will also be used for sensor integration and ECU model development.

Products:

- Advantages/disadvantages of various vehicle electrical data bus designs
- Advantages/disadvantages of various diagnostic software suites
- Vehicle CAN bus simulator
- Powertrain ECU models\
- Sensor integration network

Payoffs:

- Risk reduction facility where software & hardware can be integrated, validated, and tested prior to being fielded
- Evaluation of both stand-alone functionality and interoperability prior to being fielded
- Honest broker assessments of technologies and systems
- Provides an opportunity to familiarize ourselves with current PD TMDE software and hardware
- Ability to simulate CAN bus messages for multiple platforms without the need of a vehicle..

Schedule & Cost

Milestones	FY08 4Q	FY09 1-2Q	FY09 3-4Q	FY10 1-3Q
Diagnostic Software Evaluation				
Data Bus Evaluation				
ECU Diagnostic Comms. SW Model				
Sensor Integration and HW Evaluation				
Lab Demonstration				
TOTAL $ 450K				